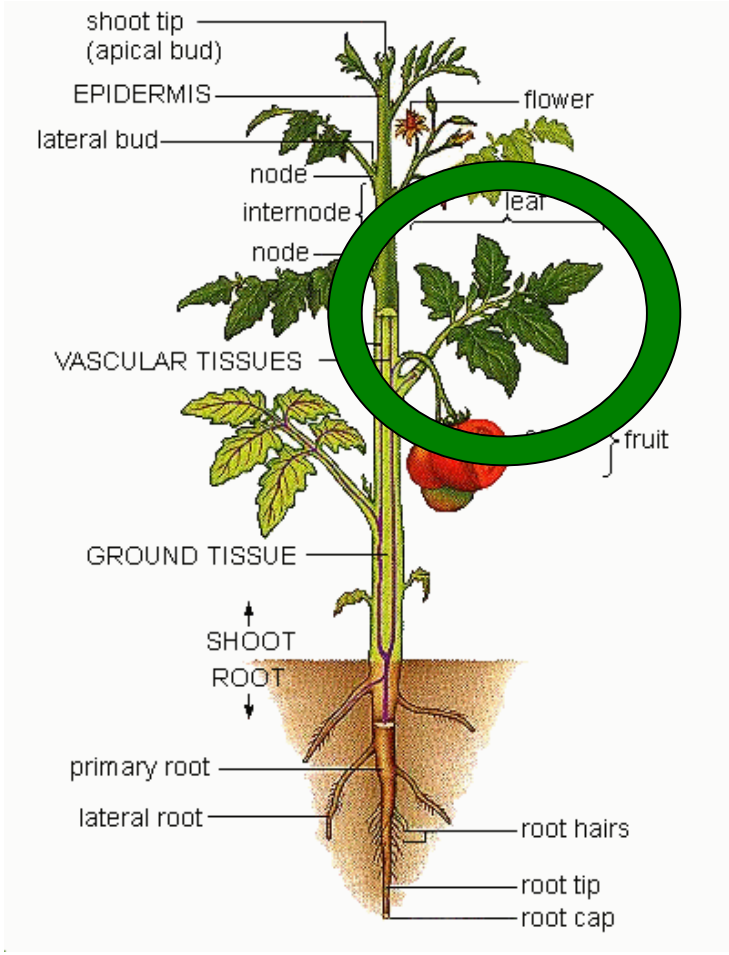
Leaves:
Form and structure

The Plant Body: Leaves

- FUNCTION OF LEAVES
  - Leaves are the solar energy and CO_2 collectors of plants.
  - In some plants, leaves have become adapted for specialized functions.



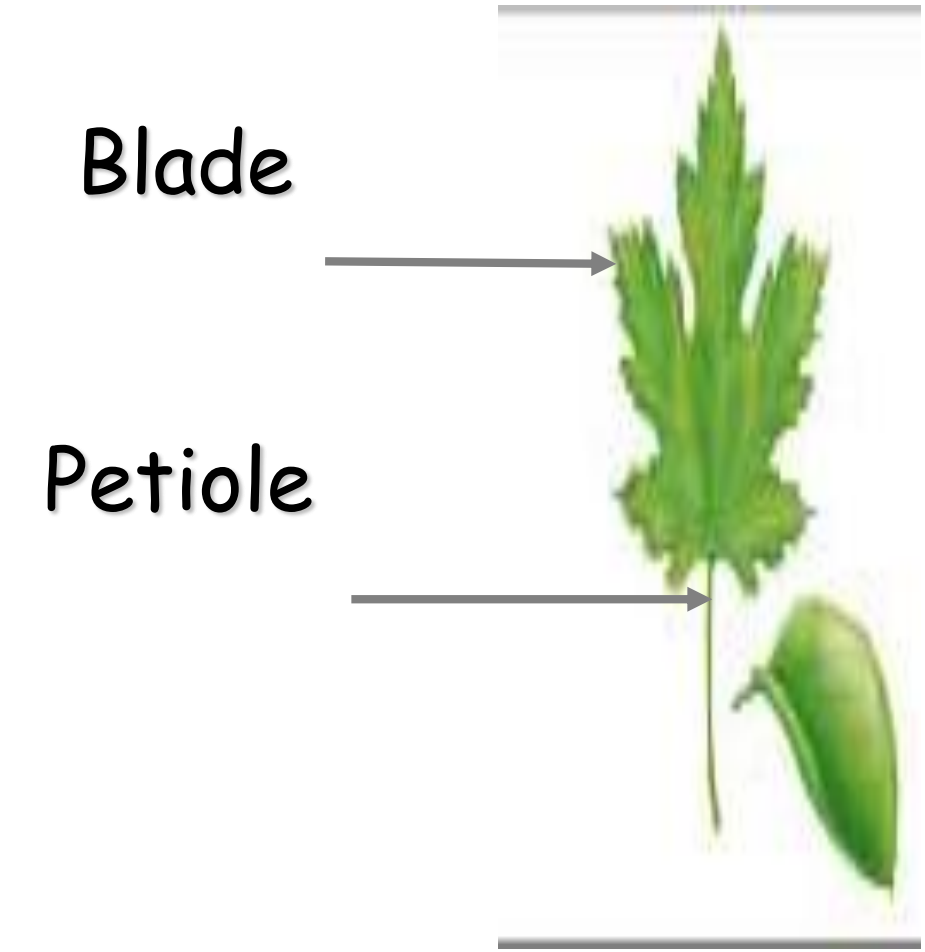
And so, on to leaves

- Leaves are the principle structure, produced on stems, where photosynthesis takes place.

- ***Cacti*** are an exception. The leaves are reduced to spines, and the thick green, fleshy stems are where photosynthesis takes place.

General leaf form

- Leaves are the main photosynthetic organs of most plants
  - but green stems are also photosynthetic.
  - While leaves vary extensively in form, they generally consist of a flattened **blade** and a stalk, the **petiole**, which joins the leaf to a stem node.
  - In the absence of petioles in grasses and many other monocots, the base of the leaf forms a sheath that envelops the stem.
- Most monocots have parallel major veins that run the length of the blade, while dicot leaves have a multi branched network of major veins.



Leaf Arrangement on the Stem

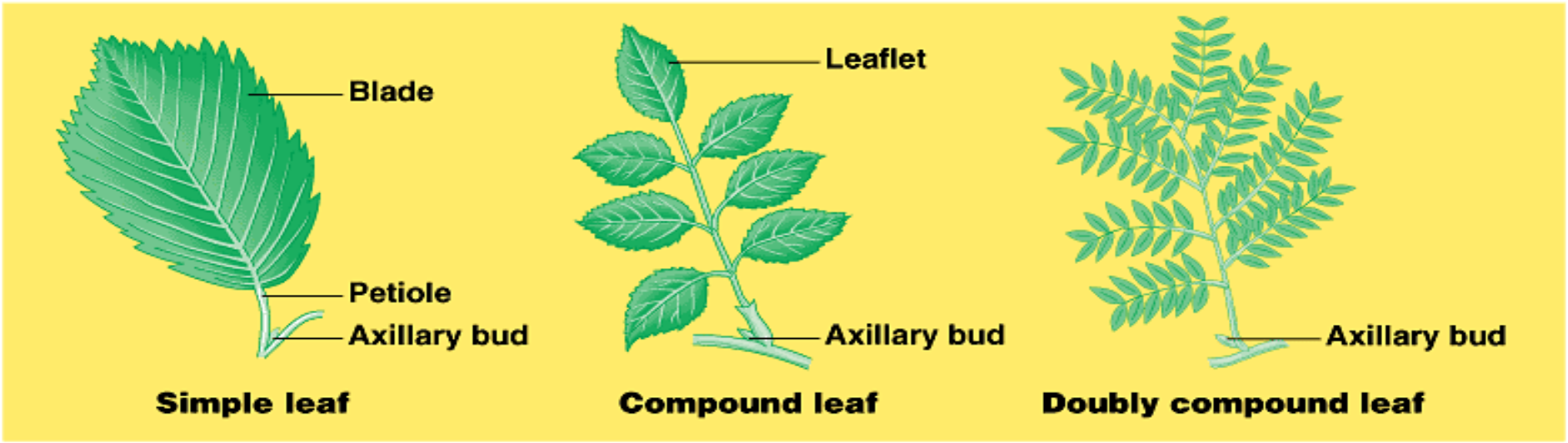
Opposite: 2 leaves at a node, on opposite sides of the stem

Spiral: 1 leaf per node, with the second leaf being above the first but attached on the opposite side of the stem

Whorled: 3 or more leaves at a node

Leaf Arrangement on the Stem

- Plant taxonomists use leaf shape, spatial arrangement of leaves, and the pattern of veins to help identify and classify plants.
  - A Simple leaves have a single, undivided blade, while compound leaves have several leaflets attached to the petiole.
  - A Compound leaf has a bud where its petiole attaches to the stem, not at the base of the leaflets.



Venation = arrangement of veins in a leaf

- Netted-venation = one or a few prominent midveins from which smaller minor veins branch into a meshed network;

Pinnately Veined

- ***common to dicots and some nonflowering plants.***
  - Pinnately-veined leaves = main vein called midrib with secondary veins branching from it (e.g., elm).
  - Palmately-veined leaves = veins radiate out of base of blade (e.g., maple).

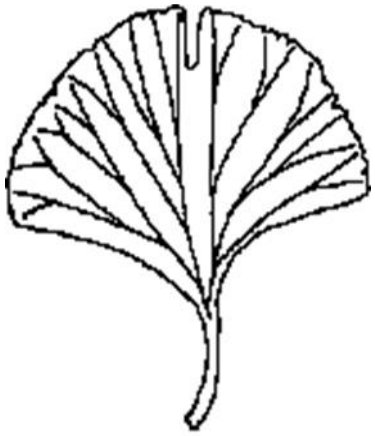
Palmately Veined

Venation = arrangement of veins in a leaf

- Parallel venation = characteristics of many monocots (e.g., grasses, cereal grains); veins are parallel to one another.

- Dichotomous venation = no midrib or large veins; rather individual veins have a tendency to fork evenly from the base of the blade to the opposite margin, creating a fan-shaped leaf

Parallel

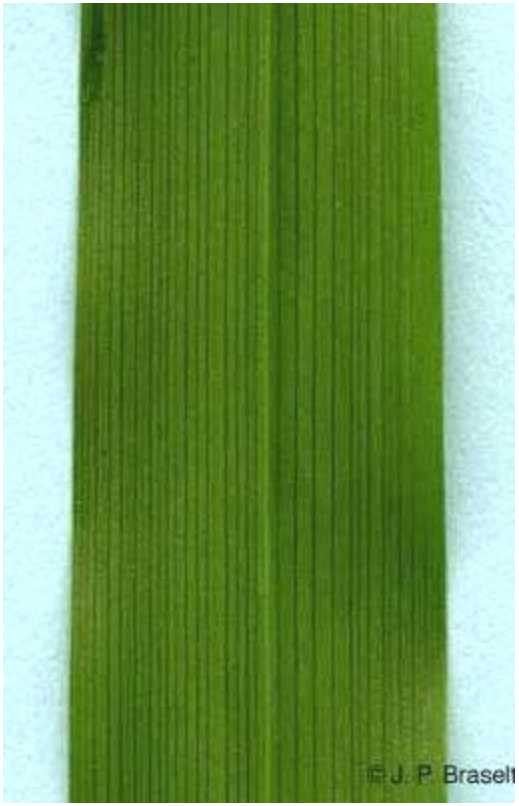


Dichotomous

Leaves - Comparisons

Monocots and dicots differ in the arrangement of **veins**, the vascular tissue of leaves

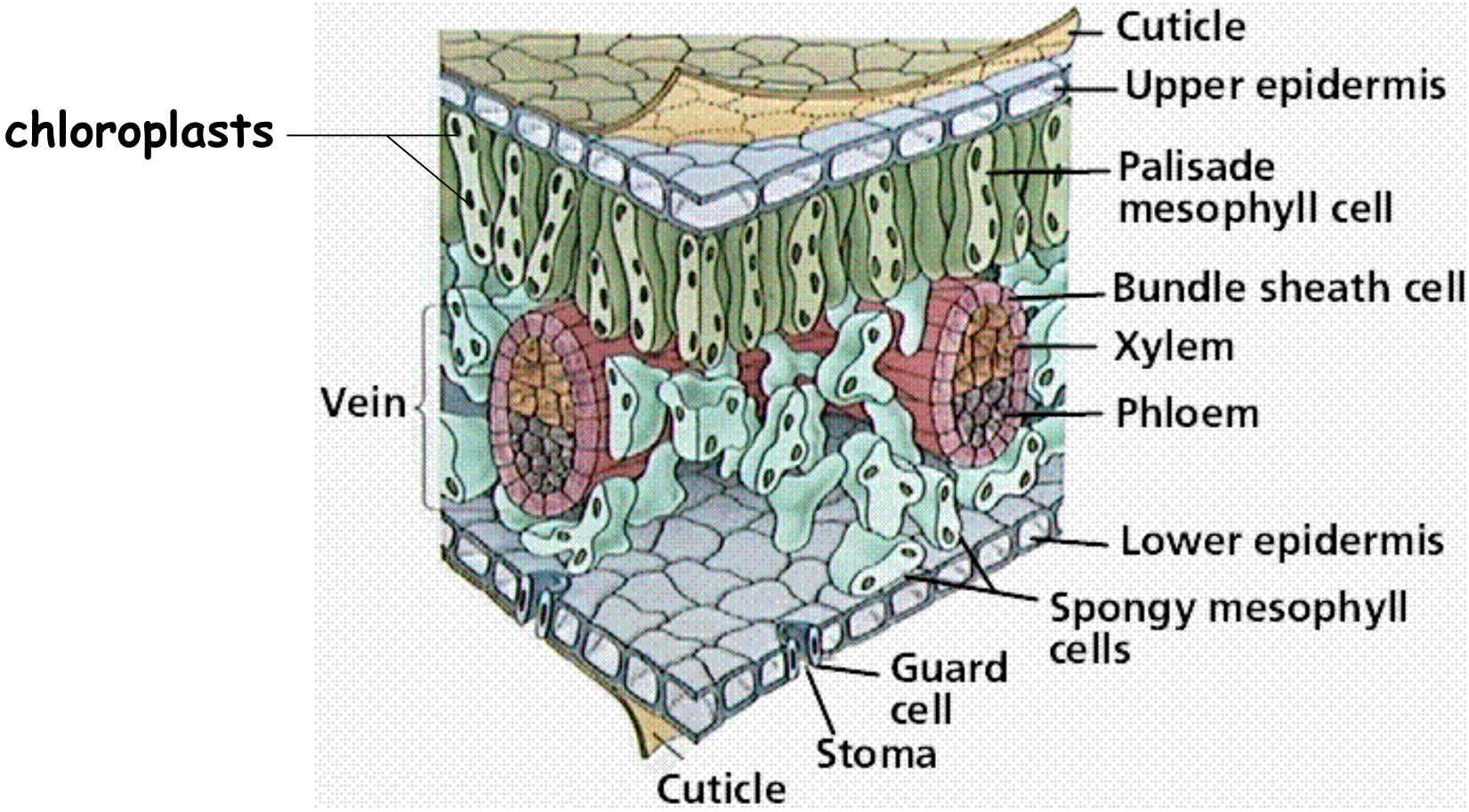
Most dicots have branch-like veins and palmate leaf shape



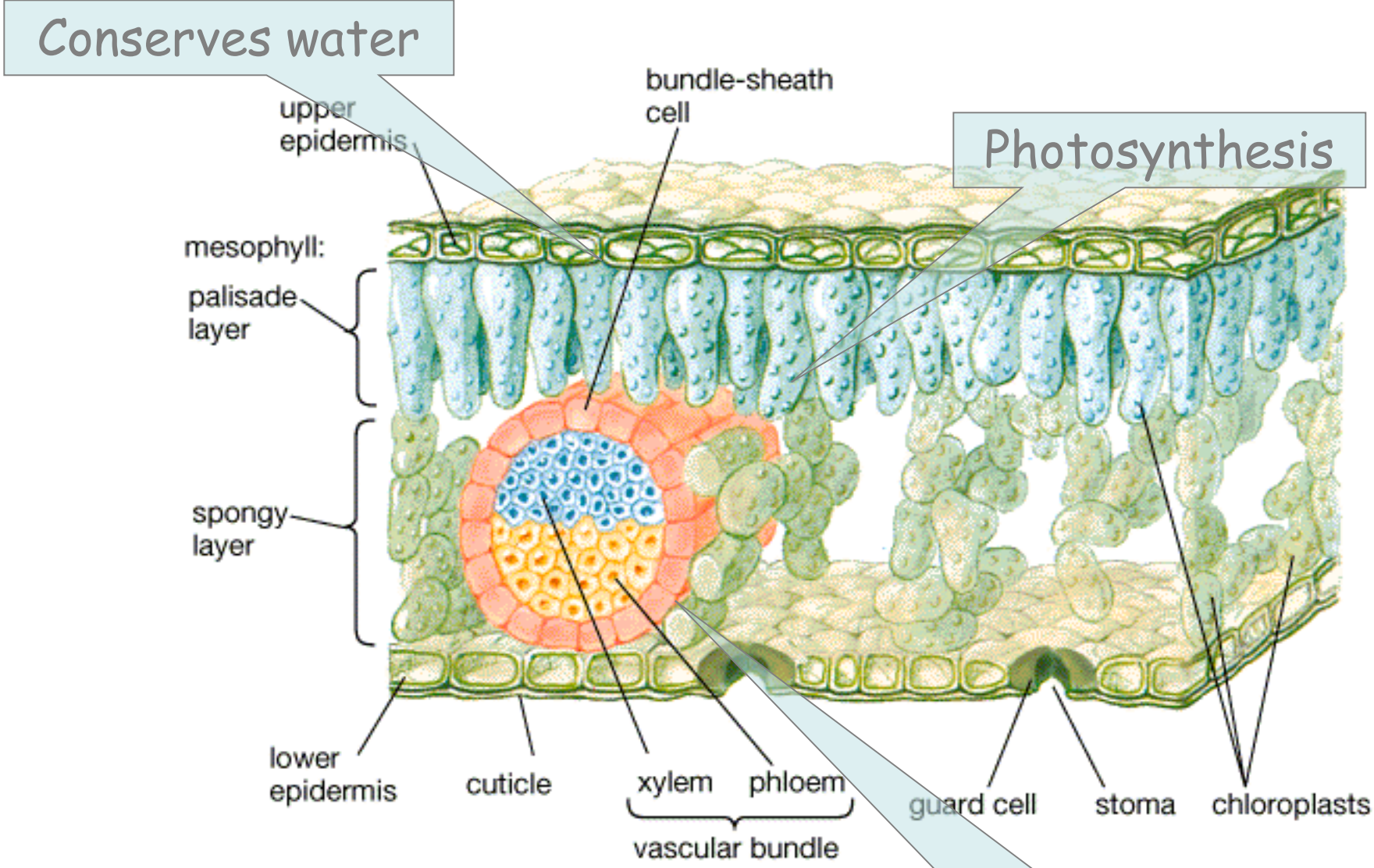
Monocots have parallel leaf veins and longer, slender blades

INTERNAL STRUCTURE OF LEAVES

- ***Each part of the leaf has an important job.***



Structures of the Leaf



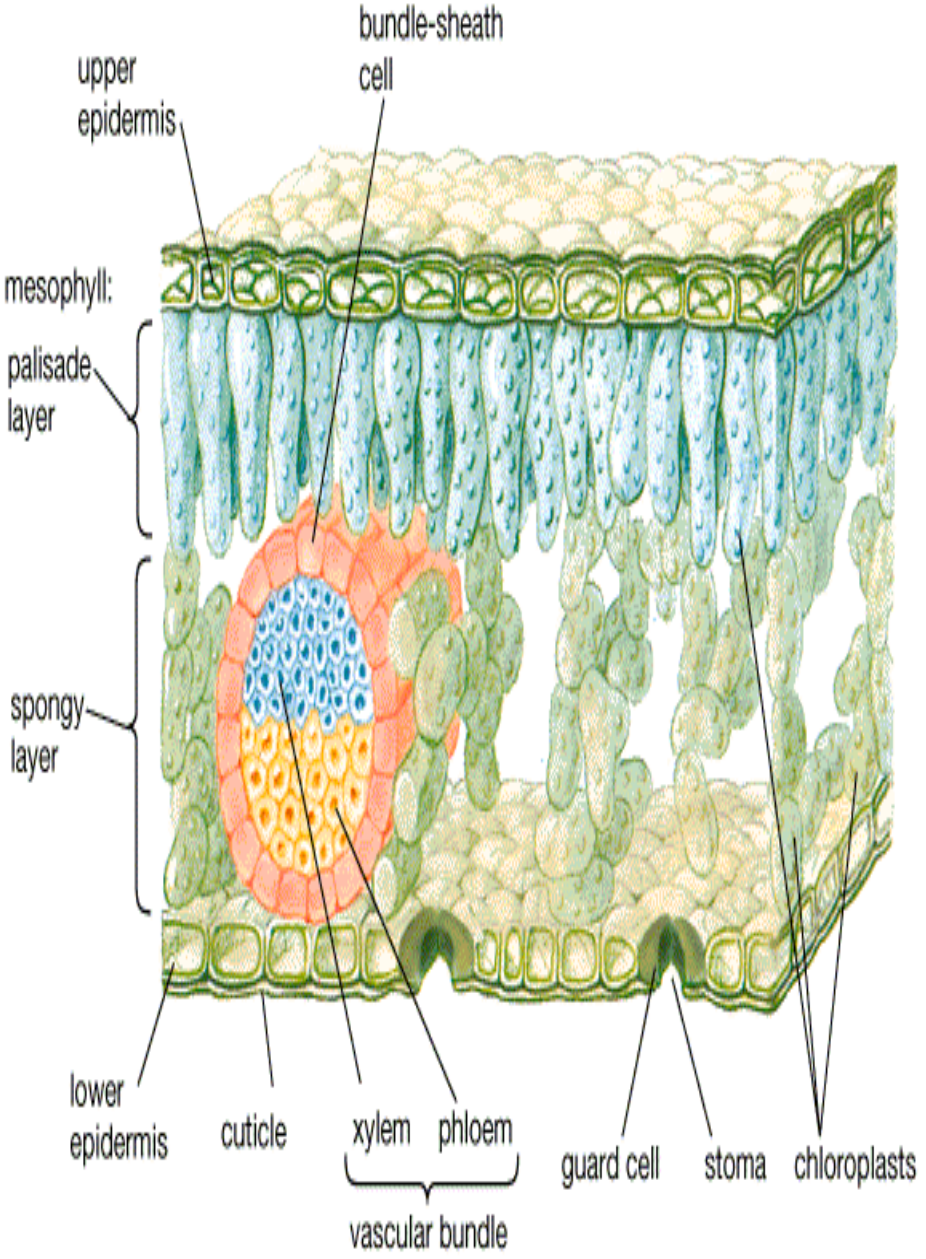
Structures of the Leaf

Cuticle – the outermost layer of both the upper and lower surfaces of the leaf. It is clear and waxy to prevent against water loss.

Epidermis – a layer of cells one cell thick that provides protection for the inner tissues. These cells are clear to allow light to reach the photosynthetic tissues.

Mesophyll – between the epidermal layers. It contains **palisade cells** that are tall, ***tightly packed, and filled with chloroplasts for photosynthesis***.

It also has **spongy cells** which are irregularly shaped, have large air spaces between them, and fewer chloroplasts.

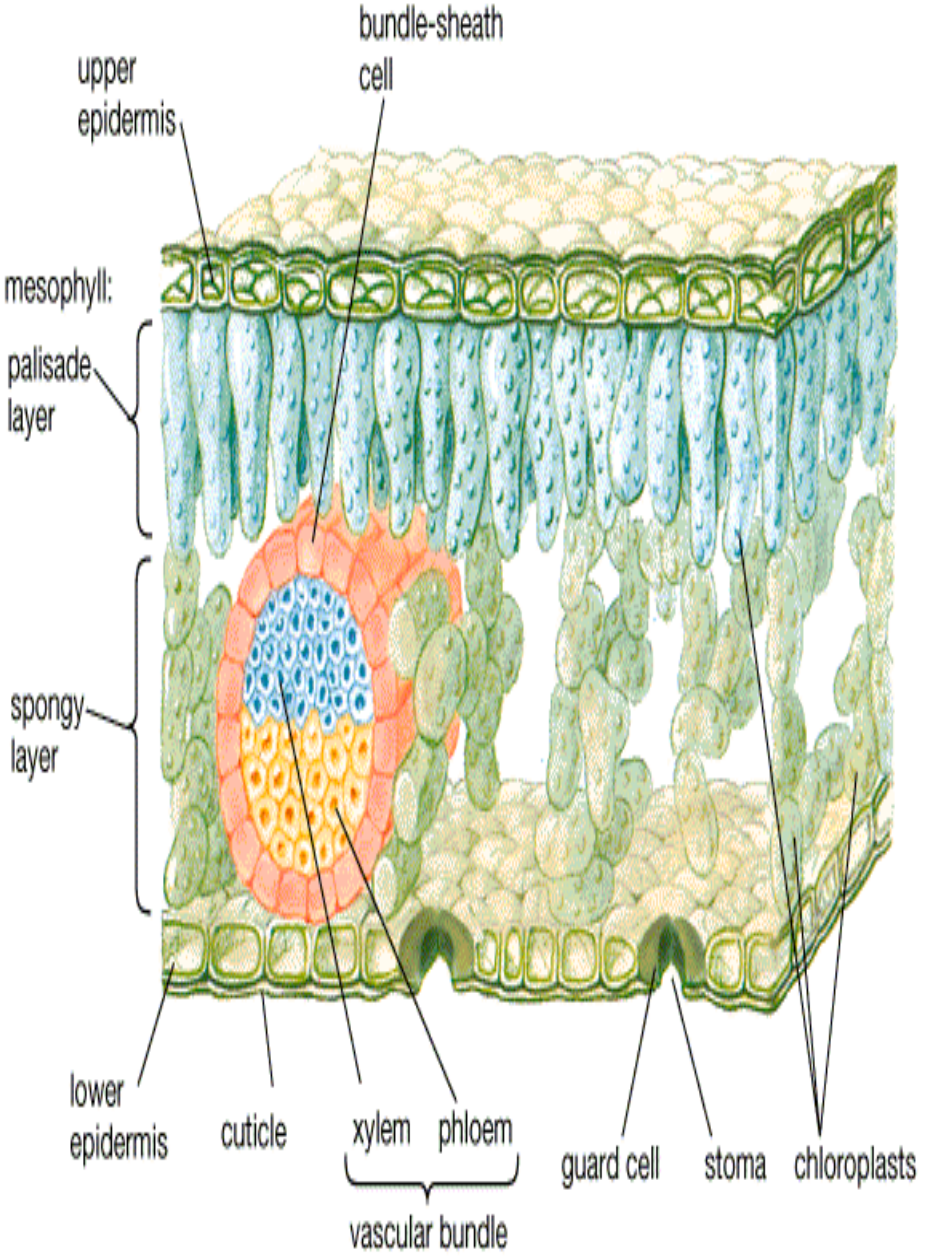


Structures of the Leaf

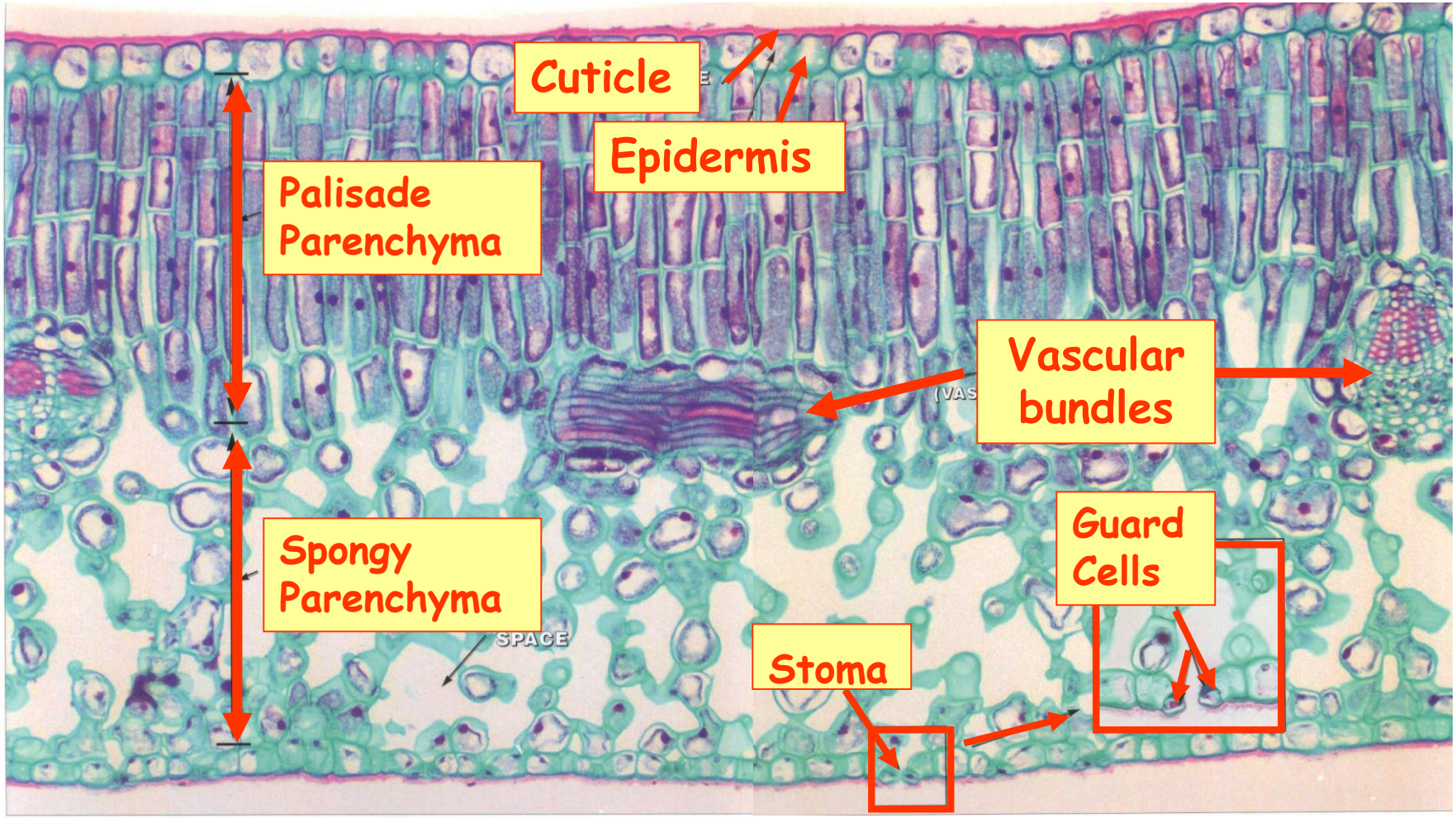
Stomates – openings in the surface of the leaf and stems for gas exchange. The lower surface of a leaf usually has more. Water vapor also passes out through these holes.

Guard cells – two of these special cells surround each stomate and regulate the opening and closing of the stomate.

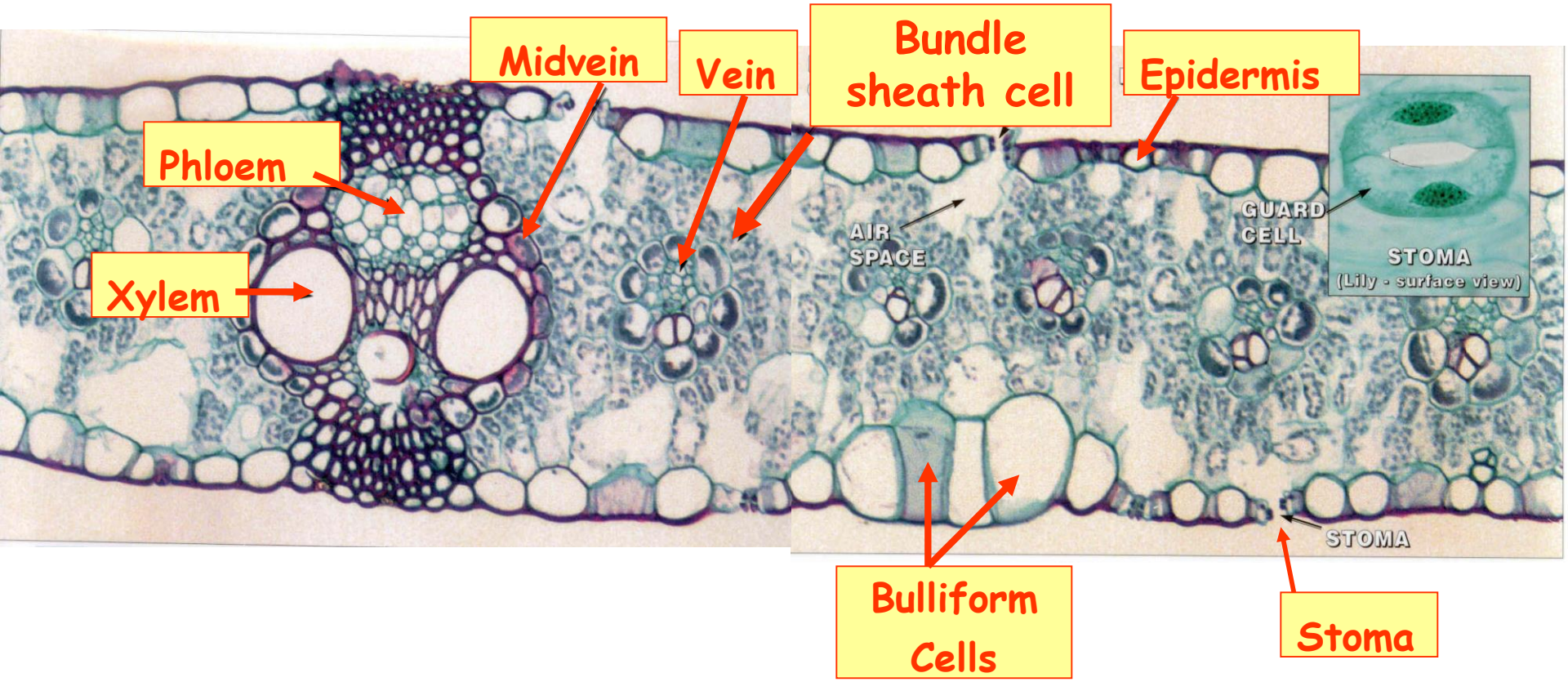
Veins – contain the vascular tissue that is continuous with that in the stem. **Xylem** carries water and minerals upward. **Phloem** carries dissolved food throughout the plant.



Typical Dicot Leaf Cross-Section



Typical Monocot Leaf Cross-Section



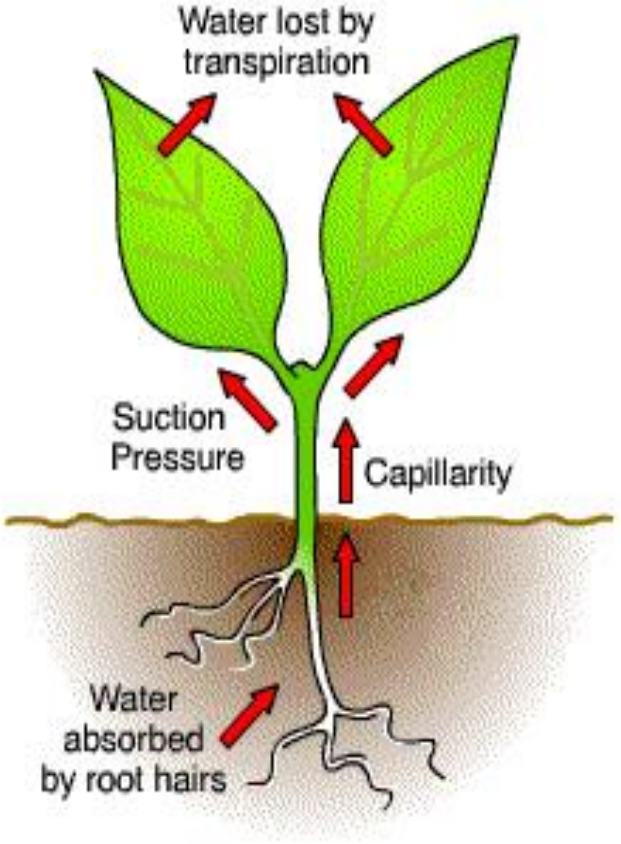
Function of the Leaf

- Photosynthesis
- Gaseous exchange
  - take in O_2 and release CO_2 during respiration
  - take in CO_2 and release O_2 during photosynthesis

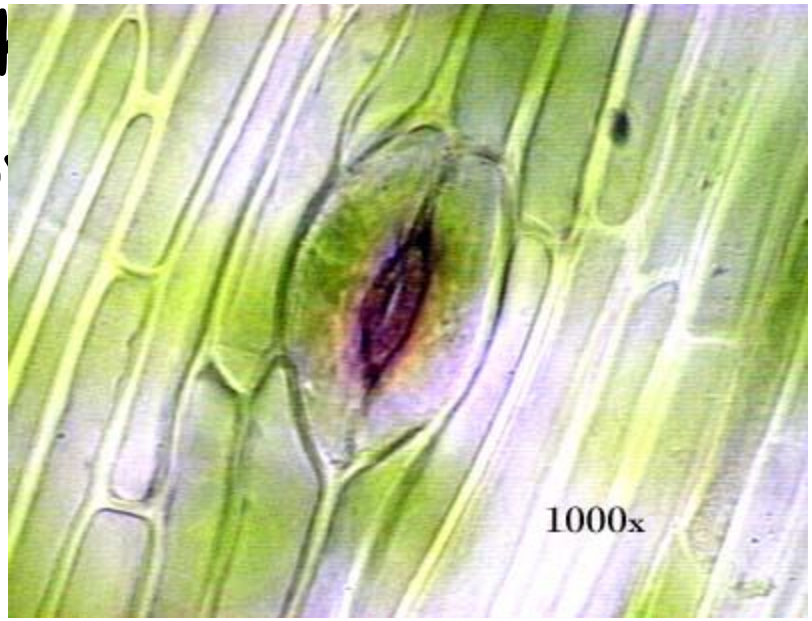
Water Vapour can be lost from the surface of the leaf in a process known as Transpiration.

TRANSPIRATION

- Plants must supply water to all their tissues. It moves from the roots up the stem to the leaves by **capillary action**.
- Most of the water plants take up is lost to the atmosphere by evaporation.
- The evaporation of water vapor from plant surfaces is called **transpiration**.
- Most takes place through stomates.



- The rate of transpiration is regulated by the size of the opening of the stomates.
- They are usually closed when there is too little water available, temperature is low, or there is little light.
- Most plants open their stomates during the day and close th
- This is controlled by the **guard cells**.



Specialized Leaves

- Some plants obtain nitrogen from digesting animals (mostly insects).
- The Pitcher plant has digestive enzymes at the bottom of the trap
- This is a "***passive trap***" Insects fall in and can not get out
- Pitcher plants have specialized vascular network to tame the amino acids from the digested insects to the rest of the plant

Pitcher plant (*Sarracenia oreophila*), showing a passive trap (pitfall type), with slippery inside surfaces and fluid pool at bottom containing digestive enzymes

Figure 11-8 (1) Biology Today, 3/e (© 2004 Garland Science)

Specialized Leaves

- The Venus fly trap has an "***active trap***"
- Good control over turgor pressure in each plant cell.
- When the trap is sprung, ion channels open and water moves rapidly out of the cells.
- Turgor drops and the leaves slam shut
- Digestive enzymes take over

When an insect touches the sensitive hairs of this Venus fly trap, the leaf halves snap together in less than half a second, trapping the insect.

Figure 11-12 (2) Biology Today, 3/e (© 2004 Garland Science)